Preliminary Results of Radiation Measurements from the Marine Stratus FIRE Experiment

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During the marine stratocumulus phase of the First International Satellite Cloud Climatology Regional Experiment (FIRE) in July 1987, we acquired radiative flux data from a variety of instruments which we flew on the NASA ER-2 high altitude aircraft. The spectral coverage ranged from the near UV to beyond 40 microns. In this paper we present a survey and selected preliminary analyses of these measurements.

The specific instruments used in the experiment were chosen primarily for measuring quantities of specific interest for marine stratocumulus fields. However, testing and evaluation of instrumentation and techniques to be used in the future inland cirrus experiment was also an important consideration. Details of the instruments and the significance of what they measure are given below.

A pair of multichannel narrow spectral band detectors spanning the near UV to near IR were mounted on the ER-2 fusilage, one each on top and bottom. Each covered a hemispherical field of view. Specific band center wavelengths were 380, 412, 500, 675, 778, 862, and 1064 nm with a typical bandwidth of 10 nm (FWHM). The measurements of interest are the reflected solar fluxes, from which spectral albedo values may be determined.

A pair of selectable solar spectral band detectors (0.2 to 3.5 or 0.6 to 3.5 micron) covering the upper and lower hemispheres were also mounted on the fusilage. Although the interpretation of these measurements is complicated by the absorption of atmospheric molecules, a rough estimate of the solar IR albedo of the cloud field may be obtained from the upwelling flux measurements. The flux results may be used together with the broad band IR flux measurements described below to determine thermal IR fluxes.

A two channel narrow spectral band and narrow field of view detector was contained in a pod mounted on the fusilage. Both elements detect upwelling radiation within a conical field half-angle of about 15 degrees. A liquid nitrogen cooled zero-radiation reference is an integral part of this detector and serves to eliminate systematic measurement errors in absolute flux determinations. One channel with a 9.90 - 10.87 micron bandwidth was designed to lie within an atmospheric transmission window. The second channel with a 6.14 - 7.14 micron bandwidth covers a strong water vibrational band. Because of the low altitudes at which marine stratus cloud fields reside it is expected that interpretation of the 6 micron channel measurements will be very difficult due to intervening water vapor absorption. However, under the proper circumstances, the 10 micron channel measurements may be used to estimate optical depths in this region of the spectra. The primary use of the 6 micron data will be as an indicator of higher altitude clouds.

A rotating platform on the wing of the ER-2 allows for 2 selectable detectors. The platform periodically rotates 180 degrees in flight so that each detector alternately measures upwelling and downwelling flux. This serves to eliminate systematic measurement errors in absolute net flux

determinations. For the majority of the flights, two hemispherical field of view detectors were used, one with a solar spectral bandwidth like that described above (0.6 to 3.5 microns) and the other with a broadband spectral sensitivity ranging from about 0.6 to beyond 40 microns. The system is designed to yield accurate net flux measurements for the solar and terestrial thermal spectral regions. Although analysis with respect to the marine stratus cloud fields is expected to have problems similar to those discussed above, it is of interest to constrast these results with those of the FIRE cirrus measurements of October 1986. The high altidutes at which the cirrus clouds resided substantially reduced the problems of interference from intervening molecular gasses.

The data are presented in the light of the above instrumental considerations. Where appropriate, comparisons are made to FIRE cirrus results.